


PROBLEM SOLVING


EXAMPLE 5 A
on p. 509
for Exs. 69–72

$$\begin{aligned}
 &71. 10; \\
 &\quad \mathcal{L}(10I) - \mathcal{L}(I) \\
 &= 10 \log \frac{10I}{I_0} - 10 \log \frac{I}{I_0} \\
 &= 10 \left(\log \frac{10I}{I_0} - \log \frac{I}{I_0} \right) \\
 &= 10 \left(\log 10 + \log \frac{I}{I_0} - \log \frac{I}{I_0} \right) \\
 &= 10 \log 10 \\
 &= 10(1) = 10 \\
 &74b. \\
 &\quad s(h) = 2 \ln(100h) \\
 &\quad = 2 \log_e(100h) \\
 &\quad = 2 \log_e 100 + 2 \log_e h \\
 &\quad = 2 \frac{\log 100}{\log e} + 2 \frac{\log h}{\log e} \\
 &\quad = 2 \frac{2}{\log e} + 2 \frac{\log h}{\log e} \\
 &\quad = \frac{2}{\log e} (2 + \log h)
 \end{aligned}$$

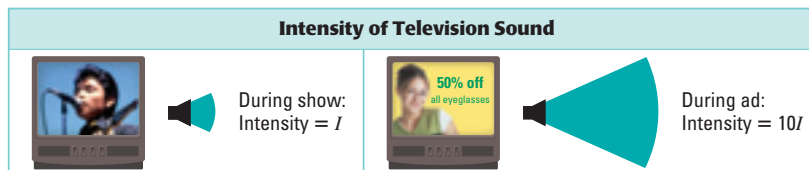
- 69. CONVERSATION** Three groups of people are having separate conversations in a room. The sound of each conversation has an intensity of 1.4×10^{-5} watts per square meter. What is the decibel level of the combined conversations in the room? **about 56 decibels**

 for problem solving help at classzone.com

- 70. PARKING GARAGE** The sound made by each of five cars in a parking garage has an intensity of 3.2×10^{-4} watts per square meter. What is the decibel level of the sound made by all five cars in the parking garage? **about 92 decibels**

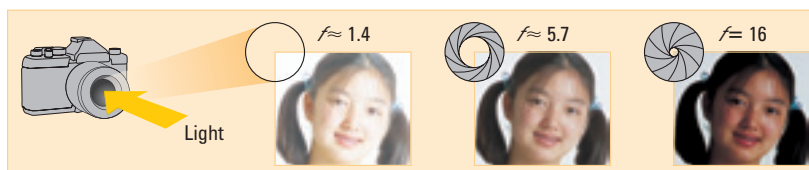
 for problem solving help at classzone.com

- B **71. ★ SHORT RESPONSE** The intensity of the sound TV ads make is ten times as great as the intensity for an average TV show. How many decibels louder is a TV ad? *Justify* your answer using properties of logarithms. **See margin.**



- 72. BIOLOGY** The loudest animal on Earth is the blue whale. It can produce a sound with an intensity of $10^{6.8}$ watts per square meter. The loudest sound a human can make has an intensity of $10^{0.8}$ watts per square meter. *Compare* the decibel levels of the sounds made by a blue whale and a human.
Sample answer: A blue whale can create sounds that are 60 decibels louder than that of a human.
- 73. ★ EXTENDED RESPONSE** The f-stops on a 35 millimeter camera control the amount of light that enters the camera. Let s be a measure of the amount of light that strikes the film and let f be the f-stop. Then s and f are related by the equation:

$$s = \log_2 f^2$$



- a. **Use Properties** Expand the expression for s . **$s = 2 \log_2 f$**
- b. **Calculate** The table shows the first eight f-stops on a 35 millimeter camera. Copy and complete the table. *Describe* the pattern you observe.
Sample answer: The amount of light increases by about 1 each time.

| f | 1.414 | 2.000 | 2.828 | 4.000 | 5.657 | 8.000 | 11.314 | 16.000 |
|-----|-------|-------|-------|-------|-------|-------|--------|--------|
| s | ? | ? | ? | ? | ? | ? | ? | ? |

about 1 2 about 3 4 about 5 6 about 7 8

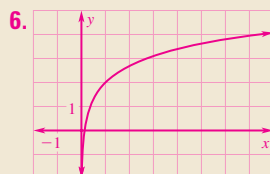
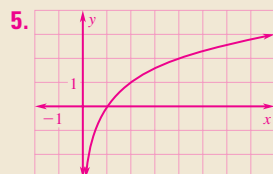
- c. **Reasoning** Many 35 millimeter cameras have nine f-stops. What do you think the ninth f-stop is? *Explain* your reasoning.
About 22.627; if you set up the equation $9 = 2 \log_2 f$ and solve for f , the result is $2^{9/2}$.

O = WORKED-OUT SOLUTIONS
on p. WS1

★ = STANDARDIZED
TEST PRACTICE

512

Quiz, p. 513



- C** 74. **CHALLENGE** Under certain conditions, the wind speed s (in knots) at an altitude of h meters above a grassy plain can be modeled by this function:

$$s(h) = 2 \ln(100h)$$

- By what factor does the wind speed increase when the altitude doubles? **about 1.386 knots**
- Show that the given function can be written in terms of common logarithms as $s(h) = \frac{2}{\log e}(\log h + 2)$. **See margin.**

MIXED REVIEW

Perform the indicated operation. (p. 187) 75–77. See margin.

$$75. \begin{bmatrix} 5 & -8 \\ 12 & 20 \end{bmatrix} + \begin{bmatrix} 6 & 7 \\ -2 & -19 \end{bmatrix} \quad 76. \begin{bmatrix} -7 & 11 \\ 6 & 3 \end{bmatrix} - \begin{bmatrix} -9 & 17 \\ -13 & 1 \end{bmatrix} \quad 77. 3 \begin{bmatrix} 1.7 & 2.4 & 6.8 \\ 9.2 & 5.3 & 7.2 \end{bmatrix}$$

Solve the equation. Check for extraneous solutions. (p. 452)

$$78. \sqrt{x+12} + 4 = 11 \quad \mathbf{37} \quad 79. \sqrt[3]{x+10} + 6 = 4 \quad \mathbf{-18} \quad 80. \sqrt{x+6} = \sqrt{3x-14} \quad \mathbf{10}$$

$$81. \sqrt[3]{2x-7} = \sqrt[3]{8-x} \quad \mathbf{5} \quad 82. \sqrt{x-1} = x-3 \quad \mathbf{5} \quad 83. x+2 = \sqrt{9x+28} \quad \mathbf{8}$$

Use a calculator to evaluate the expression.

$$84. e^8 \text{ (p. 492)} \quad \mathbf{\text{about 2981}} \quad 85. e^{-6} \text{ (p. 492)} \quad \mathbf{\text{about 0.00248}} \quad 86. e^{3.5} \text{ (p. 492)} \quad \mathbf{\text{about 33.12}} \quad 87. e^{-0.4} \text{ (p. 492)} \quad \mathbf{\text{about 0.670}}$$

$$88. \log 12 \text{ (p. 499)} \quad \mathbf{\text{about 1.079}} \quad 89. \log 1.8 \text{ (p. 499)} \quad \mathbf{\text{about 0.255}} \quad 90. \ln 24 \text{ (p. 499)} \quad \mathbf{\text{about 3.178}} \quad 91. \ln 8.49 \text{ (p. 499)} \quad \mathbf{\text{about 2.139}}$$

QUIZ for Lessons 7.4–7.5

Evaluate the logarithm without using a calculator. (p. 499)

$$1. \log_4 16 \quad \mathbf{2} \quad 2. \log_5 1 \quad \mathbf{0} \quad 3. \log_8 8 \quad \mathbf{1} \quad 4. \log_{1/2} 32 \quad \mathbf{-5}$$

Graph the function. State the domain and range. (p. 499) 5–7. See margin for art.

$$5. y = \log_2 x \quad \mathbf{\text{domain: } x > 0, \text{ range: all real numbers}} \quad 6. y = \ln x + 2 \quad \mathbf{\text{domain: } x > 0, \text{ range: all real numbers}} \quad 7. y = \log_3(x+4) - 1 \quad \mathbf{\text{domain: } x > -4, \text{ range: all real numbers}}$$

Expand the expression. (p. 507)

$$8. \log_2 5x \quad \mathbf{\log_2 5 + \log_2 x} \quad 9. \log_5 x^7 \quad \mathbf{7 \log_5 x} \quad 10. \ln 5xy^3 \quad \mathbf{\ln 5 + \ln x + 3 \ln y} \quad 11. \log_3 \frac{6y^4}{x^8} \quad \mathbf{\log_3 6 + 4 \log_3 y - 8 \log_3 x}$$

Condense the expression. (p. 507)

$$12. \log_3 5 - \log_3 20 \quad \mathbf{\log_3 \frac{1}{4}} \quad 13. \ln 6 + \ln 4x \quad \mathbf{\ln 24x} \quad 14. \log_6 5 + 3 \log_6 2 \quad \mathbf{\log_6 40} \quad 15. 4 \ln x - 5 \ln x \quad \mathbf{\ln \frac{1}{x}}$$

Use the change-of-base formula to evaluate the logarithm. (p. 507)

$$16. \log_3 10 \quad \mathbf{\text{about 2.096}} \quad 17. \log_7 14 \quad \mathbf{\text{about 1.356}} \quad 18. \log_5 24 \quad \mathbf{\text{about 1.975}} \quad 19. \log_8 40 \quad \mathbf{\text{about 1.774}}$$

20. **SOUND INTENSITY** The sound of an alarm clock has an intensity of $I = 10^{-4}$ watts per square meter. Use the model $L(I) = 10 \log \frac{I}{I_0}$, where $I_0 = 10^{-12}$ watts per square meter, to find the alarm clock's loudness $L(I)$. (p. 507) **80 decibels**


EXTRA PRACTICE for Lesson 7.5, p. 1016

 **ONLINE QUIZ** at classzone.com

513

5 ASSESS AND RETEACH

Daily Homework Quiz

 **Transparency Available**

Use $\log_5 20 \approx 1.861$ and $\log_5 8 \approx 1.292$ to evaluate the logarithm.

- $\log_5 160$ **3.153**
- $\log_5 8000$ **5.583**
- Expand $\ln \frac{\sqrt[3]{x}}{y^2}$. **$\frac{1}{3} \ln x - 2 \ln y$**
- Condense $5 \log_2 x - 4 \log_2 y$.
 $\log_2 \frac{x^5}{y^4}$
- Use the change-of-base formula to evaluate $\log_4 50$. **2.822**
- The intensity level of an electric guitar is $10^{2.8}$ watts per square meter. Use the formula $L(I) = 10 \log \frac{I}{I_0}$, where $I_0 \approx 10^{-12}$ watts per square meter, to find the decibel level of the guitar. **about 28 decibels**

Online Quiz

Available at **classzone.com**

Diagnosis/Remediation

- Practice A, B, C in Chapter 7 Resource Book, pp. 54–56
- Study Guide in Chapter 7 Resource Book, pp. 57–58
- Practice Workbook, pp. 116–117
- @HomeTutor

Challenge

Additional challenge is available in the Chapter 7 Resource Book, p. 61.

Quiz

An easily-readable reduced copy of the quiz (with answers) on Lessons 7.4–7.5 from the Assessment Book can be found on p. 476E.

$$75. \begin{bmatrix} 11 & -1 \\ 10 & 1 \end{bmatrix}$$

$$76. \begin{bmatrix} 2 & -6 \\ 19 & 2 \end{bmatrix}$$

$$77. \begin{bmatrix} 5.1 & 7.2 & 20.4 \\ 27.6 & 15.9 & 21.6 \end{bmatrix}$$